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AN UNCONDITIONALLY STABLE SEMI-IMPLICIT CUT FINITE ELEMENT IMMERSED BOUNDARY METHOD

Kyle G. Dunn[1,*], Marcus Sarkis[2] and Roger Lui[3]

[1] Worcester Polytechnic Institute, 100 Institute Rd. Worcester, MA 01609, kgdunn@wpi.edu, http://users.wpi.edu/∼kgdunn
[2] Worcester Polytechnic Institute, 100 Institute Rd. Worcester, MA 01609, msarkis@wpi.edu, http://users.wpi.edu/∼msarkis
[3] Worcester Polytechnic Institute, 100 Institute Rd. Worcester, MA 01609, rlui@wpi.edu, http://users.wpi.edu/∼rlui

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Originally developed for the numerical analysis of cardiac blood flow, the immersed boundary method introduced by Peskin [1] has gained popularity in various computational applications. Due to its growth in popularity across many applications, there has been a recent surge in effort to further study this method. Specifically, we seek to improve the finite element approach introduced by Boffi et al. in [2]. In this talk we introduce a finite element method for the Stokes equations with a massless immersed membrane. The membrane applies normal and tangential forces affecting the velocity and pressure of the fluid. Additionally, the points representing this membrane move with the local fluid velocity. We design and implement a high-accuracy cut finite element method (CutFEM) [3, 4] which enables the use of a structured mesh that is not aligned with the immersed membrane. Then we formulate a time discretization that yields an unconditionally stable scheme. We prove that the stability is not restricted by the parameter choices that constrained previous finite element immersed boundary methods and illustrate the theoretical results with numerical simulations.

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